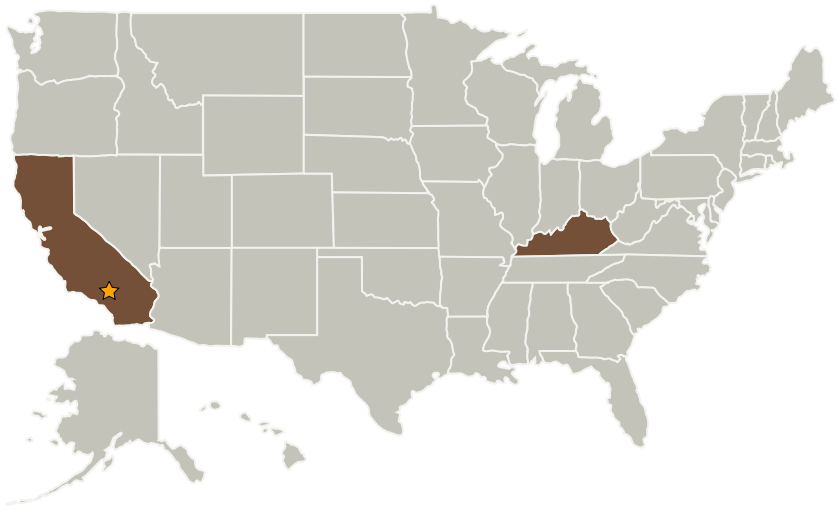
Integrated Variable-Fidelity Tool Set for Modeling and Simulation of Aeroservothermoelasticity-Propulsion (ASTE-P) Effects for Aerospace Vehicles Ranging From Subsonic to Hypersonic Flight, Phase II

Completed Technology Project (2007 - 2009)

Project Introduction

The proposed research program aims at developing a variable-fidelity software tool set for aeroservothermoelastic-propulsive (ASTE-P) modeling that can be routinely applied to the design of aerospace vehicles. The toolset can be applied to conventional vehicle types as well as hypersonic vehicles. The major issues involved in ASTE-P modeling and simulation will be significantly and extensively investigated in this project, which include full coupling between fluid/structure/control dynamics, the aeroservothermoelastic-propulsive instability, the viscous/turbulent effects, shock and shock-boundary layer interaction, as well as the large unsteady and highly nonlinear aerothermal dynamic loading on structure of vehicles. The interface of the structure/control surface dynamic vibration modes with flows will be modeled using particle-based material point method (MPM) in an integrated dynamic fluid-structure interaction environment. The MPM is essentially a particle-based method which avoids dealing with the time-varying mesh distortions and boundary variations due to structure/control surface deformations and/or motions (i.e. wing flutters, FCS/structural mode interaction, PSD turbulence response), thus being significantly more robust and computationally efficient than the traditional finite element methods that must utilize moving-boundary and mesh-regeneration. The results achieved in Phase I have demonstrated the initial capability; the end software in Phase II will be fully capable of ASTE-P analysis and evaluation for aerospace vehicles.

Primary U.S. Work Locations and Key Partners



Integrated Variable-Fidelity Tool Set for Modeling and Simulation of Aeroservothermoelasticity-Propulsion (ASTE-P) Effects for Aerospace Vehicles Ranging From Subsonic to Hypersonic Flight, Phase II

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Completed Technology Project (2007 - 2009)

Organizations Performing Work	Role	Type	Location
★Armstrong Flight Research Center(AFRC)	Lead Organization	NASA Center	Edwards, California
Advanced Dynamics, Inc.	Supporting Organization	Industry Minority-Owned Business	Lexington, Kentucky

Primary U.S. Work Locations	
California	Kentucky

Project Transitions

December 2007: Project Start

December 2009: Closed out

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Armstrong Flight Research Center (AFRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  - TX15.2 Flight Mechanics
    - TX15.2.2 Flight Performance and Analysis